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Two new species of *Mediomastus* (Annelida, Capitellidae) from Tokyo Bay, Japan

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Abstract

Two undescribed species of polychaetes in *Mediomastus* (Annelida: Capitellidae) were collected from intertidal to shallow habitats in Tokyo Bay, Japan. These are *M. duobalteus* **sp. n.** and *M. hanedaensis* **sp. n.** *Mediomastus duobalteus* **sp. n.** is distinguishable from all congeners by the following characters: 1) segments 3, 4, 8–11 stainable with methyl green, 2) thoracic capillary chaetae unilimbate, 3) abdominal capillary chaetae absent, 4) paddle-like chaetae in the thorax absent, and 5) abdominal hooded hooks not flared. *Mediomastus hanedaensis* **sp. n.** is similar to *M. warrenae* Green, 2002, but differs from the latter in the shapes of the thoracic capillary chaetae and the abdominal hooded hooks, and the staining pattern with methyl green. In addition, a key to all *Mediomastus* species is provided.

Keywords

Taxonomy, morphology, polychaete, Pacific

Introduction

Capitellids in the genus *Mediomastus* Hartman, 1944 are benthic polychaete worms that occur in marine and brackish water. *Mediomastus* is distinguishable from other genera in Capitellidae by the following characters: 1) peristomium (segment 1) without chaetae, 2) thorax with 10–12 segments, 3) segments 2–5 with capillary chaetae in both

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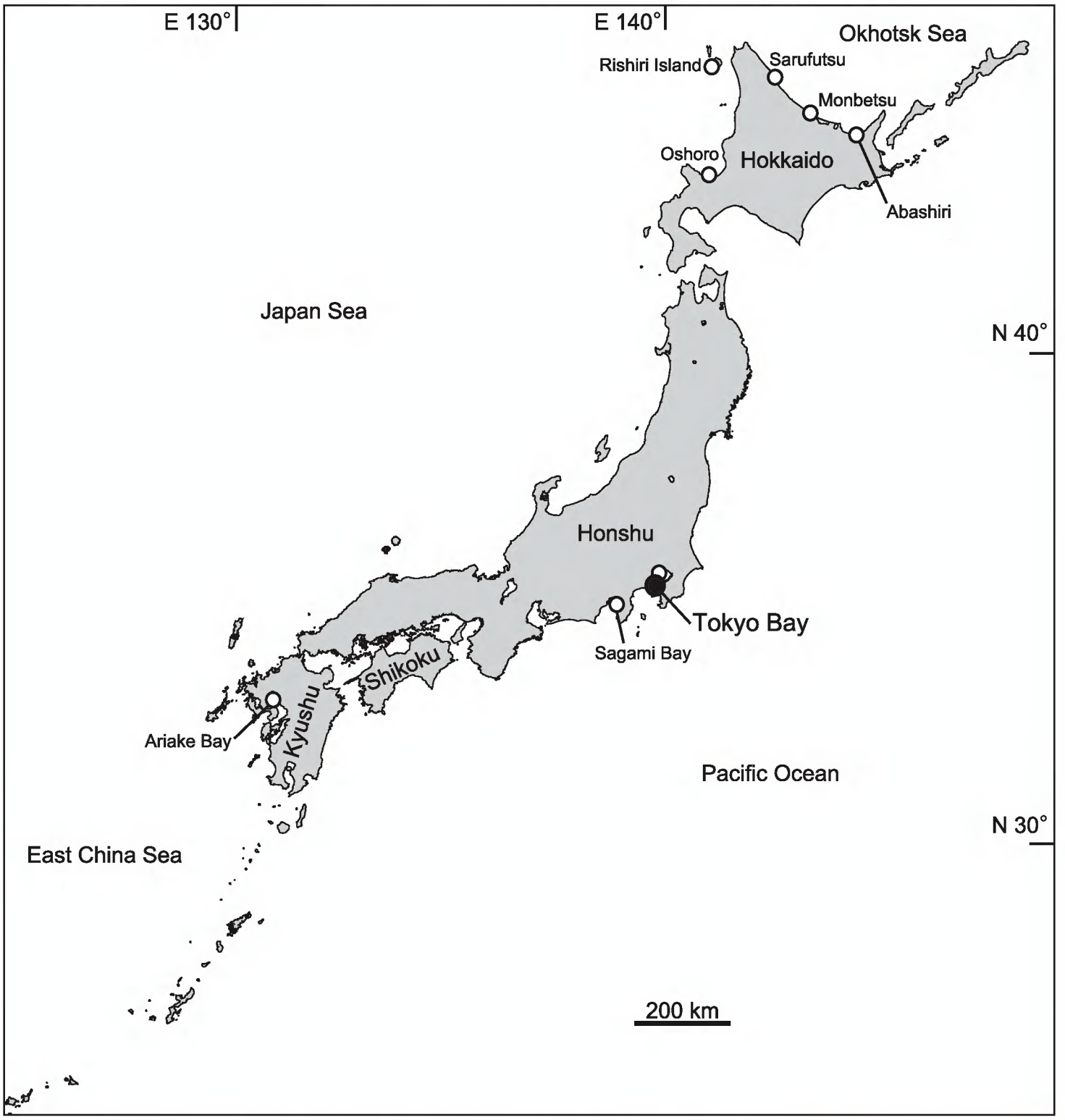

Figure 1. Map showing the distribution of *Mediomastus* records in Japan. Open circles, previous studies; closed circle, this study. Sources: Rishiri Island (Kato et al. 2003, Tomioka et al. 2014); Sarufutsu (Imajima 1992); Monbetsu (Tomioka et al. 2014); Abashiri (Tomioka et al. 2013); Oshoro (Tomioka et al. 2014); Tokyo Bay (Nishi and Tanaka 2007, Nishi et al. 2009); Sagami Bay (Imajima 2006); Ariake Bay (Suyama et al. 2003, Niki et al. 2006).

rami, and 4) remaining thoracic and abdominal segments with hooded hooks (Hartman 1944, Warren et al. 1994, Green 2002). The genus was originally established for *M. californiensis* Hartman, 1944 (Hartman 1944) and now contains 14 species (Tomioka et al. 2013). In Japan, species in the genus have been reported from eight localities (Fig. 1, references therein), but only two of these records were identified to species: *M. californiensis* from Sagami Bay (Imajima 2006) and *M. opertaculeus* from Hokkaido (Abashiri, Monbetsu, Rishiri Island, and Oshoro) (Tomioka et al. 2013, 2014).

Nishi and Tanaka (2007) reported the occurrence of representatives of *Mediomastus* in Tokyo Bay but did not identify their material to species. Our capitellid specimens from Tokyo Bay were collected during an environmental assessment for the Haneda Airport re-expansion project (Nishi et al. 2009). They turned out to comprise two undescribed species, which we describe and illustrate in this paper. In addition, we provide a key to all species in *Mediomastus*.

Materials and methods

Worms were collected from sandy mud sediment off Haneda, at the mouth of the Tamagawa River, Tokyo Bay, Japan. All specimens were fixed in 10% formalin in seawater and were later transferred to 70% ethanol after rising in deionized water. Morphological observation and methyl-green staining were performed as described by Tomioka et al. (2013). All specimens have been deposited in the Natural History Museum and Institute, Chiba, Japan. Morphological terminology follows that of Warren et al. (1994).

Systematics

Mediomastus duobalteus sp. n.

http://zoobank.org/BD73215A-6470-4BE1-A439-A3F6ED585513
Figs 2–6

Material examined. Holotype: CBM–ZW 1088, Haneda, Tokyo Bay, St. L3e-2-1 (35.52783203°N, 139.7884979°E, sandy mud bottom, incomplete, collected May 2012. Paratypes (six specimens): CBM-ZW 1089, Haneda, Tokyo Bay, St. L4e-1-1, 35.52949905°N, 139.7836609°E, incomplete; mounted on SEM stub, collected spring 2007; CBM-ZW 1090, Haneda, Tokyo Bay, St. L2b-2, 35.52531815°N, 139.7931824°E, sandy-mud bottom, 5 m depth, incomplete, some parts of body mounted on slides, remaining parts preserved in 70% ethanol, collected May 2012; CBM-ZW 1091, Haneda, Tokyo Bay, St. 07s-L4e-1-2, 35.52949905°N, 139.7836609°E, sandy mud bottom, incomplete, collected spring 2007; CBM-ZW 1092, St. 07s-L4e-1-3, 35.52949905°N, 139.7836609°E, sandy mud bottom, incomplete, collected spring 2007; CBM-ZW 1093, St. 07s-L4e-1-4, 35.52949905°N, 139.7836609°E, incomplete, collected spring 2007; CBM-ZW 1094, Haneda, Tokyo Bay, St. L4e-1-2, sandy mud bottom, incomplete, collected May 2012.

Description. Holotype, anterior fragment with 73 segments; 18.0 mm in length; 0.51 mm in maximum width. Body color white in ethanol. Epithelium smooth. Nephridiopores lacking. Branchiae absent. All segments cylindrical. Sex uncertain.

Prostomium (Fig. 2A) conical, with short palpode; eversible proboscis with numerous minute papillae. Peristomium twice as long as chaetiger 1, without eyespots, achaetigerous.

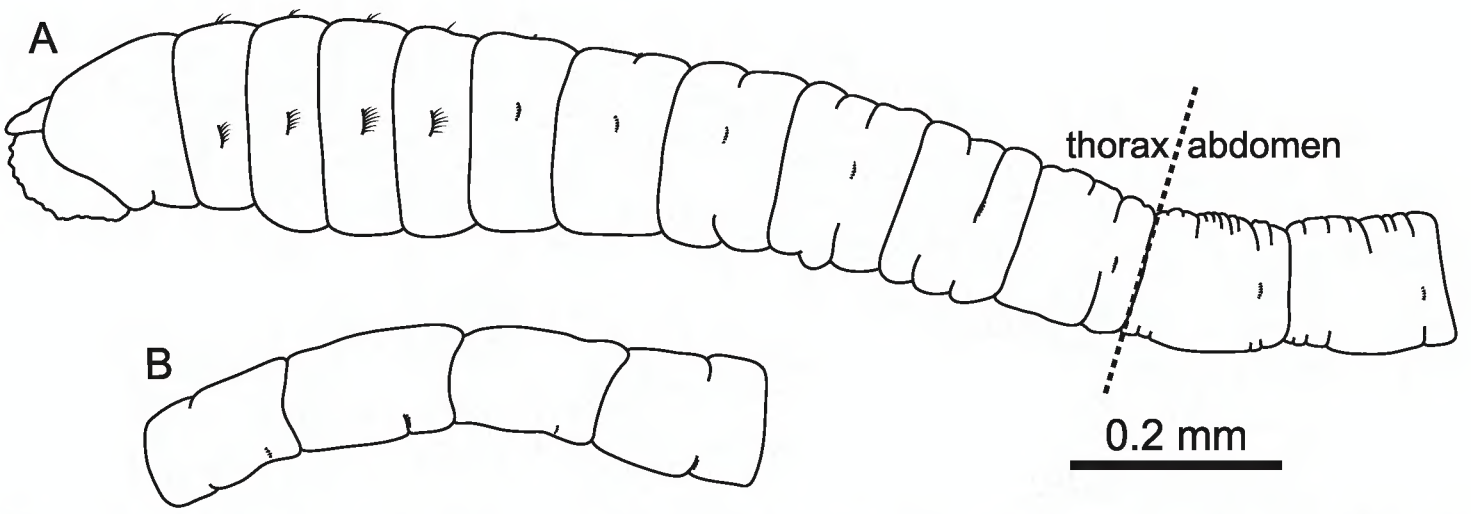

Figure 2. *Mediomastus duobalteus* sp. n., holotype, CBM-ZW 1088. **A** Anterior end of body, left lateral view **B** abdominal segments, left lateral view.

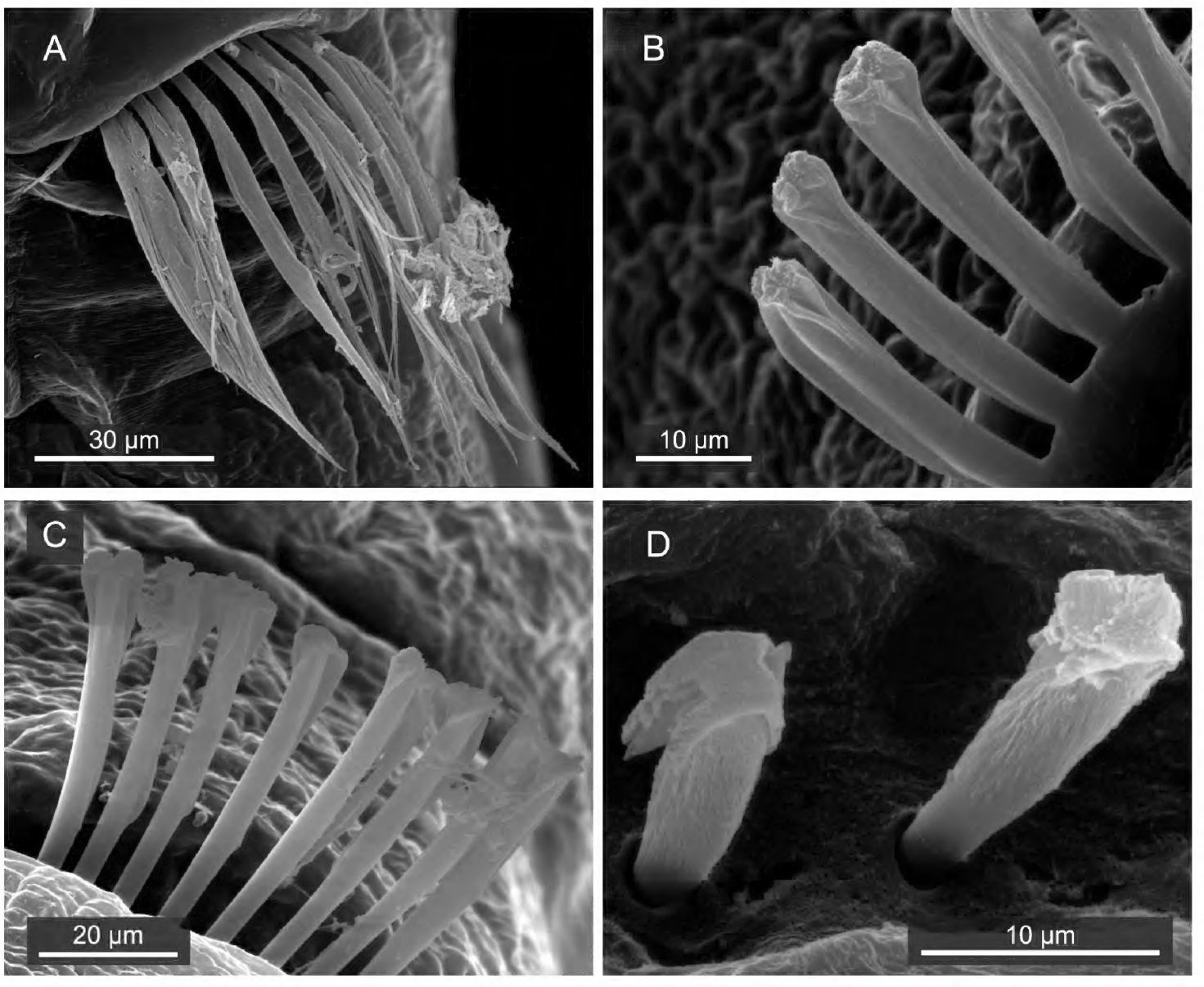

Figure 3. *Mediomastus duobalteus* sp. n., paratype, CBM-ZW 1089, SEM images. **A** Capillary chaetae on segment 3 **B** notopodial hooded hooks on segment 6 **C** neuropodial hooded hooks on segment 6 **D** notopodial hooded hooks on segment 13.

Capillary chaetae unilimbate, with narrow wing (Figs 3A, 4A), present on chaetigers 1–4; noto- and neurochaetae each 8–12 in number per fascicle (Fig. 3A). Chaetigers 5–10 with hooded hooks, but without paddle-like chaetae. Notopodial hooded

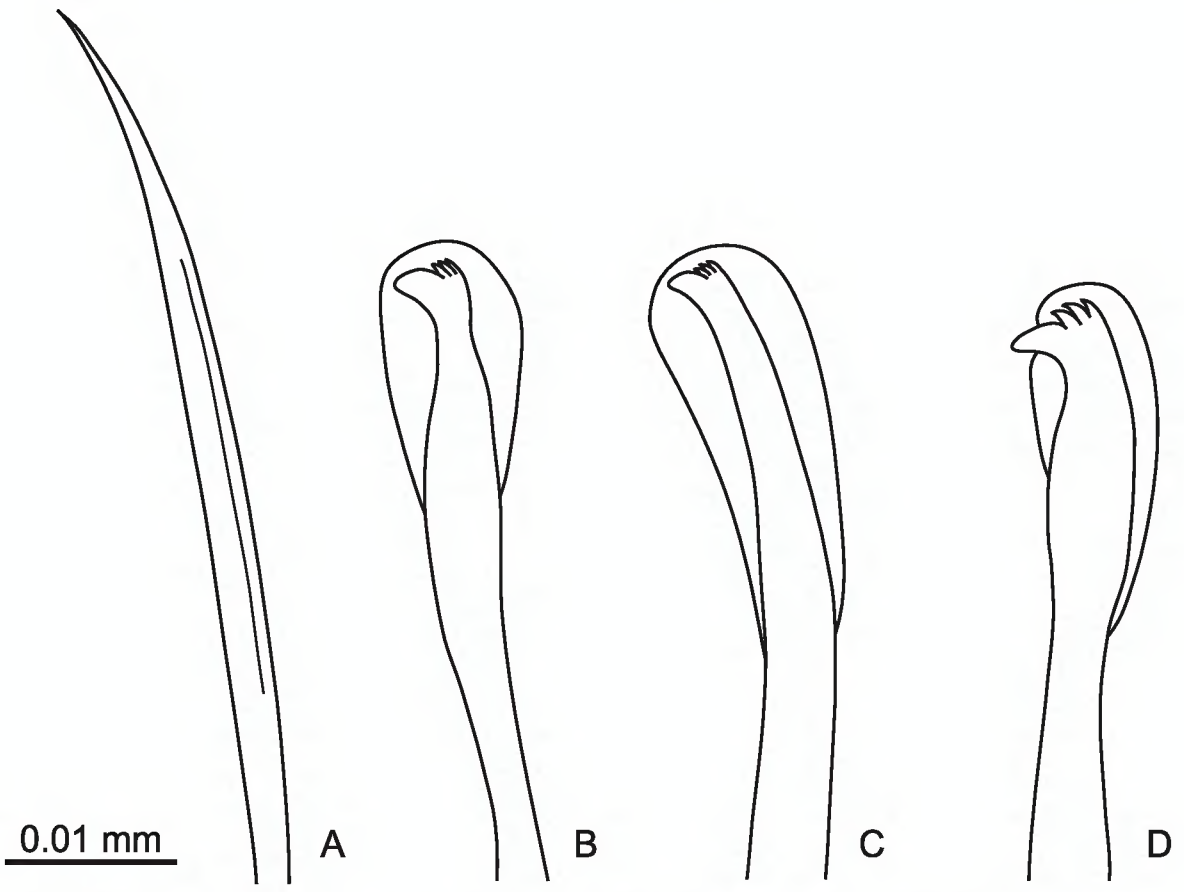

Figure 4. *Mediomastus duobalteus* sp. n., paratype, CBM-ZW 1090. **A** Capillary chaeta from segment 2 **B** notopodial hooded hook from segment 6 **C** neuropodial hooded hook from segment 6 **D** notopodial hooded hook from segment 20.

hooks (Figs 3B, 4B) with short, stout fang and 3 fine teeth (Fig. 4B); hood with opening (Fig. 3B); shaft without constriction (Fig. 4B); shoulder indistinct (Fig. 4B); 6–10 hooks per fascicle. Neuropodial hooded hooks (Figs 3C, 4C) with short, stout fang and 3 fine teeth (Fig. 4C); hood with small opening (Fig. 3C); shaft without constriction (Fig. 4C); shoulder indistinct (Fig. 4C); 5–10 hooks per fascicle (Fig. 4C).

Abdominal segments twice as long as wide (Fig. 2B); with hooded hooks only. Hooded hooks (Figs 3D, 4D) with stout, pointed fang and 3 coarse teeth (Fig. 4D); hood with opening (Fig. 3D); shaft without constriction (Fig. 4D); shoulder indistinct; 2–6 hooks per fascicle.

Transition from thorax to abdomen marked by change in shape of hooded hooks; hooded hooks in thorax have small fang with fine, small teeth (Fig. 4B, C), while those in abdomen have stout, pointed fang; coarse and large teeth (Fig. 4D).

Methyl-green staining. Among seven specimens observed, methyl-green staining resulted in three patterns (Fig. 5). All patterns showed two bands of numerous, dense, minute spots: one band on segments 2 and 3, or 3 and 4; the other extending from segments 8 or 10 to segment 11. Figure 6 shows a stained worm having the pattern diagrammed in Fig. 5C.

Etymology. The specific name is a noun in the nominative singular, from the Latin numeral *duo* ("two") and the Latin noun *balteus* ("belt"), referring to the species' diagnostic staining pattern, in which the staining pattern is two belt-like bands.

Remarks. Among 14 congeners, *M. duobalteus* most closely resembles *M. warrenae*, but differs from the latter in the staining pattern with methyl green (segments 5

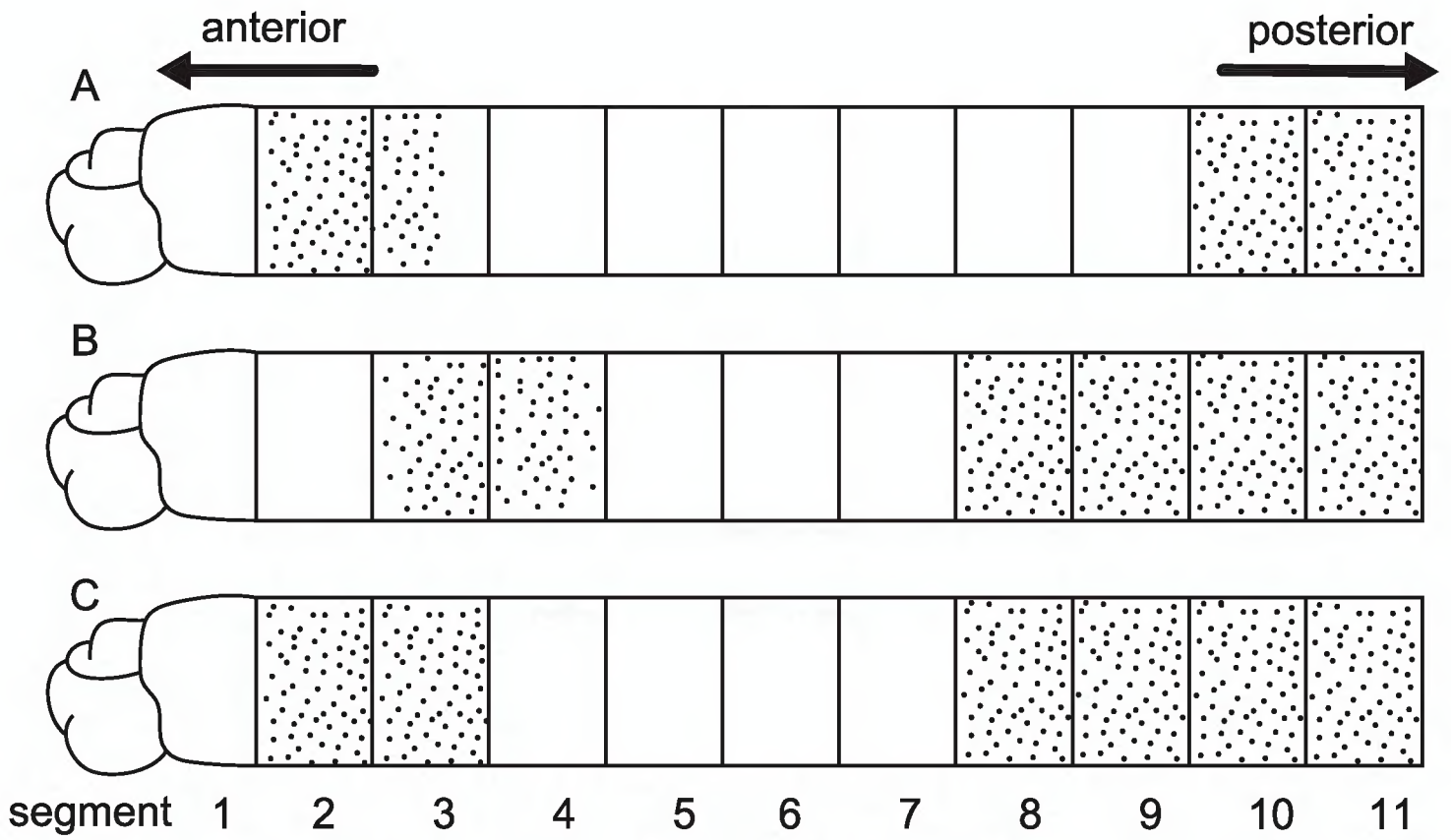

Figure 5. Diagram showing the three methyl-green staining patterns observed in the thorax (consisting of 11 segments) among seven specimens of *Mediomastus duobalteus* sp. n. **A** Paratype, CBM-ZW 1089 **B** holotype, CBM-ZW 1088 **C** paratype, CBM-ZW 1094.

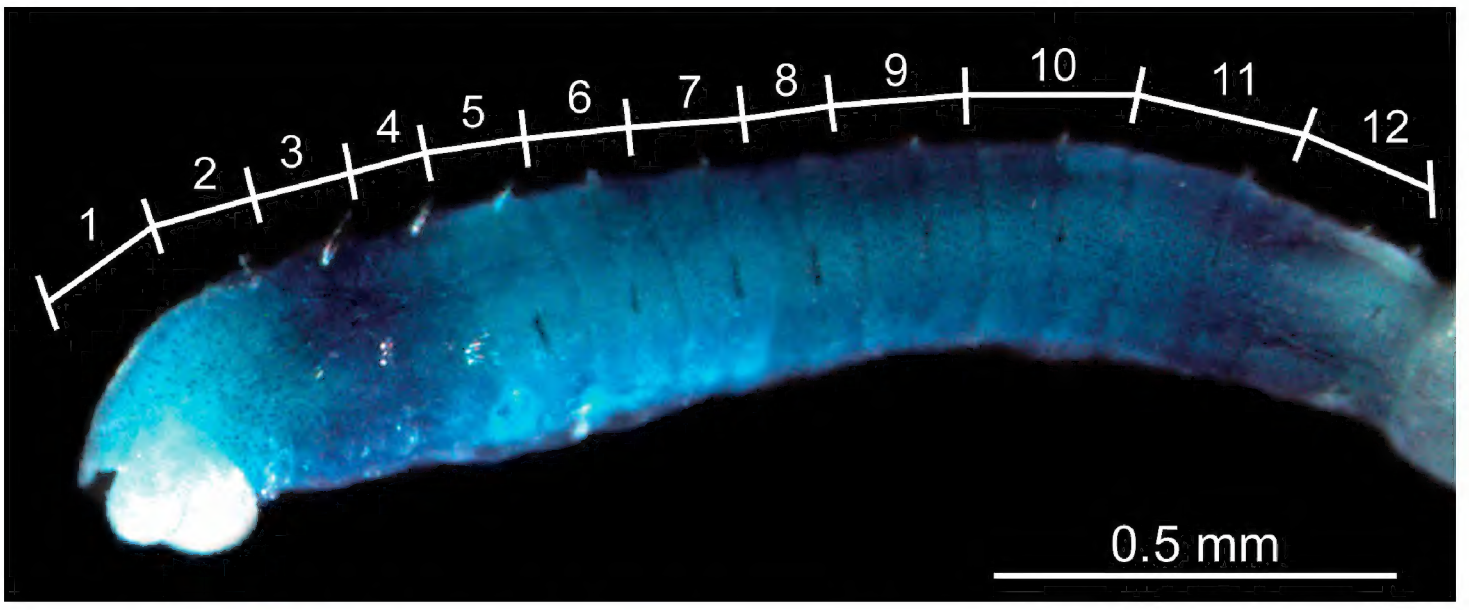

Figure 6. Photograph of the thorax of *Mediomastus duobalteus* sp. n., holotype, CBM-ZW 1088, showing the methyl-green staining pattern, with the segment numbers and segmental boundaries labeled.

and 6 lack spots in *M. duobalteus* but are darkly stained post-chaetally in *M. warrenae*), the shape of the thoracic capillary chaetae (unilimbate in *M. duobalteus* vs. bilimbate in *M. warrenae*), and the shape of the abdominal hooded hooks (constriction absent in *M. duobalteus* but present in *M. warrenae*).

***Mediomastus hanedaensis* sp. n.**
http://zoobank.org/CE8D8CDA-3450-4E4D-86C6-AC40DD6EA18B
Figs 7–11

Material examined. Holotype: CBM-ZW 1095, Haneda, Tokyo Bay, St. 07s-L4e-1-c, 35.52949905°N, 139.7836609°E, incomplete. Paratypes (two specimens): CBM-ZW 1096, same collection site as holotype, incomplete, mounted on SEM stub; CBM-ZW 1097, same collection site as holotype, incomplete, cut into 5 portions, all mounted on two slides. All specimens collected spring 2007.

Description. Holotype incomplete, with 27 segments, sex uncertain; 16.2 mm in length; 1.33 mm in maximum width. Body color whitish yellow in ethanol. Epithelium smooth. Nephridiopores lacking. Branchiae absent. All segments cylindrical.

Prostomium (Fig. 7A) conical, with short palpode; eversible proboscis with numerous minute papillae. Peristomium 1.2 times as wide as long, slightly longer than chaetiger 1, without eyespot, achaetigerous.

Thoracic chaetigers biannulate. Thin, unilimbate, capillary chaetae with narrow wing (Figs 8A, 9A) present on chaetigers 1–4; noto- and neurochaetae each 8–13 in number per fascicle (Fig. 8A). Chaetigers 5–10 with hooded hooks, but without paddle-like chaetae. Notopodial hooded hooks (Figs 8B, 9B) with short, blunt fang and 6 teeth (Fig. 9B); hood with small opening (Fig. 8B); shaft not constricted (Fig. 9B); shoulder indistinct (Fig. 9B); 6–8 hooks per fascicle (Fig. 8B). Neuropodial hooded hooks (Figs 8C, 9C) with short, stout fang and 7 teeth (Fig. 9C); hood with small opening (Fig. 8C); shaft without constriction (Fig. 9C); shoulder indistinct (Fig. 9C); 4–7 hooks per fascicle (Fig. 8C).

Abdominal segments 2.5 times as wide as long (Fig. 7B), with hooded hooks only. Hooded hooks with long fang and 3 teeth (Figs 8D, 9D); fangs in abdominal hooks longer and sharper than those in thoracic hooks; opening of hood wider than that of thoracic hooks; shaft with distinct constriction (Fig. 9D); 2–5 hooks per fascicle (Fig. 8D).

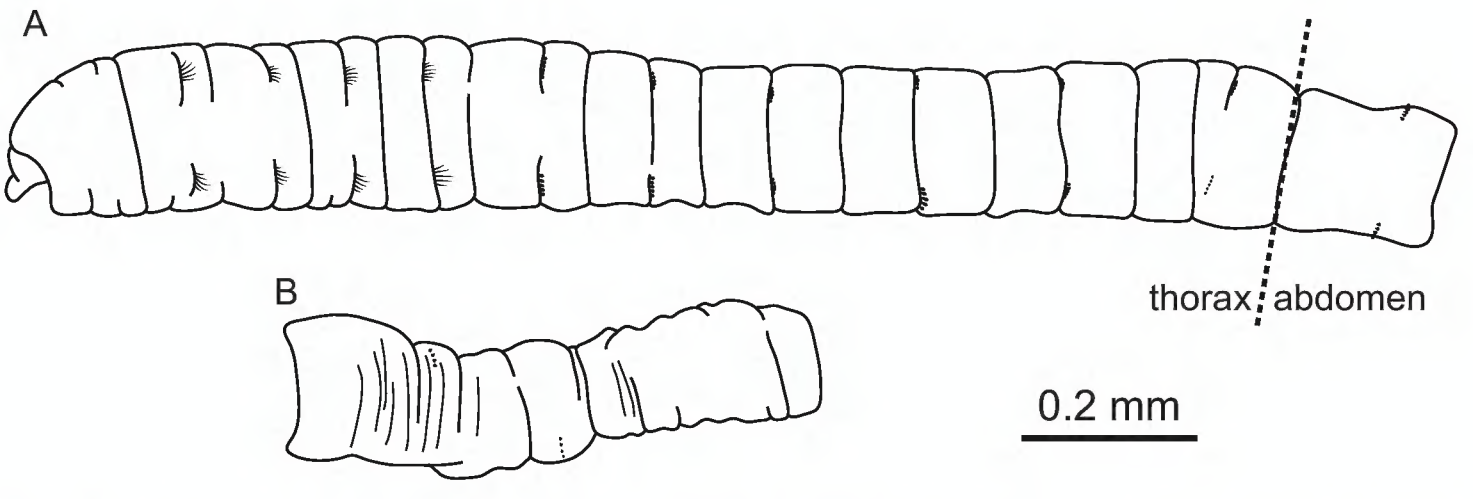

Figure 7. *Mediomastus hanedaensis* sp. n., holotype, CBM-ZW 1095. **A** Anterior end of body, left lateral view **B** abdominal segments, left lateral view.

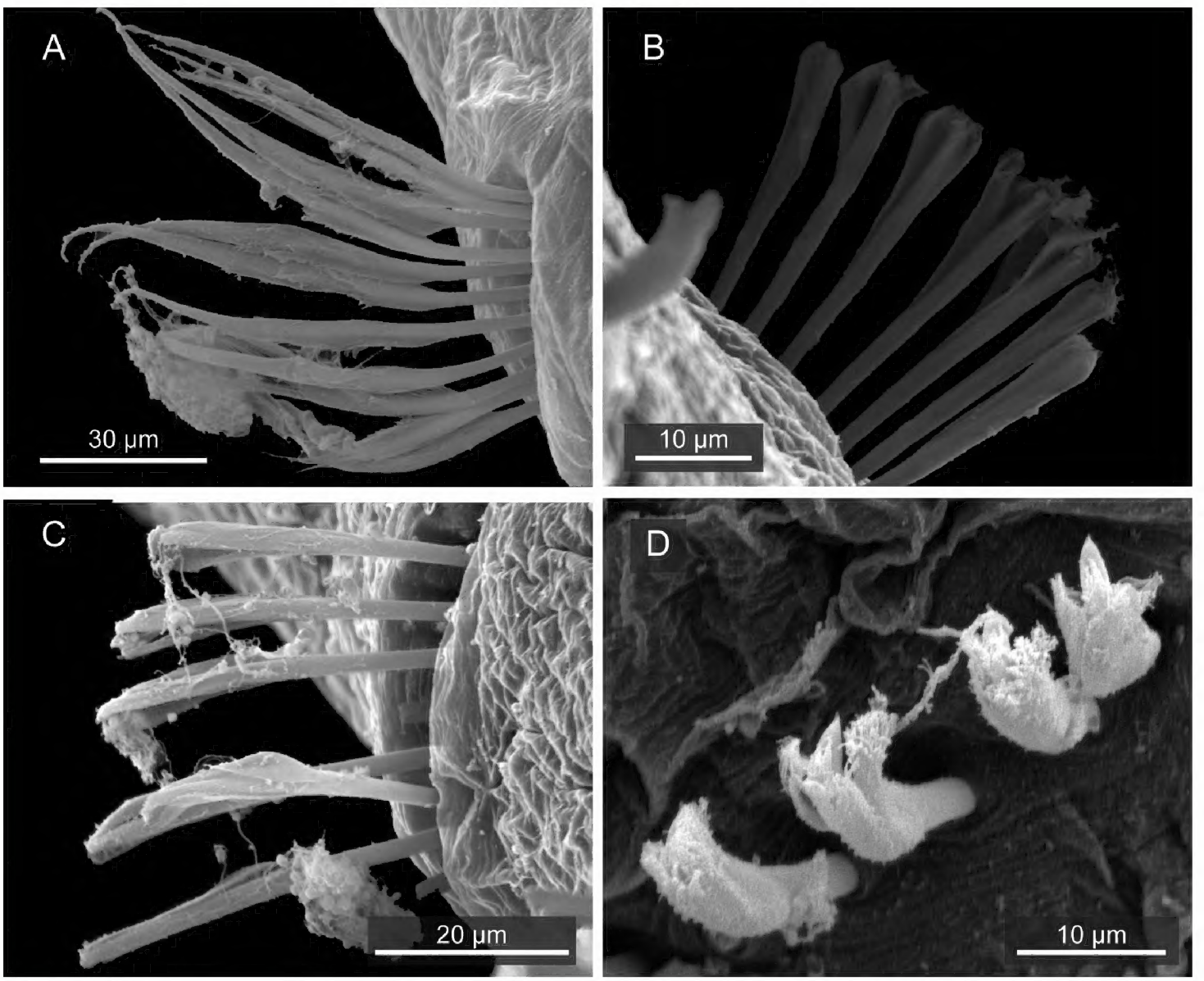

Figure 8. *Mediomastus hanedaensis* sp. n., paratype, CBM-ZW 1096, SEM images. **A** Capillary chaetae on segment 3 **B** notopodial hooded hooks on segment 6, with an arrowhead indicating hood opening **C** neuropodial hooded hooks on segment 6 **D** notopodial hooded hooks on segment 33.

Transition from thorax to abdomen marked by alteration in shape of segments (longer in abdomen), shape of shaft of hooded hooks (with constriction in abdominal hooks), and length of fang of hooded hooks (longer in abdominal hooks).

Methyl-green staining. Among the three specimens observed, methyl-green staining resulted in three patterns (Fig. 10). Numerous minute spots sparsely and uniformly covered segments 5–9, 7–10, or 8–10; segment 10 (Fig. 10A) or 11 (Fig. 10B, C) with denser spots. Figure 11 shows the stained worm diagrammed in Fig. 10A.

Etymology. The specific name is an adjective, referring to the type locality.

Remarks. *Mediomastus hanedaensis* is similar to *M. warrenae* in the shape of the thoracic hooded hooks, but differs from the latter in the staining pattern with methyl green (segments 8 and 9 uniformly spotted in *M. hanedaensis* vs. post-chaetally spotted in *M. warrenae*) and in the shape of the thoracic capillary chaetae (unilimbate in *M. hanedaensis* vs. bilimbate in *M. warrenae*).

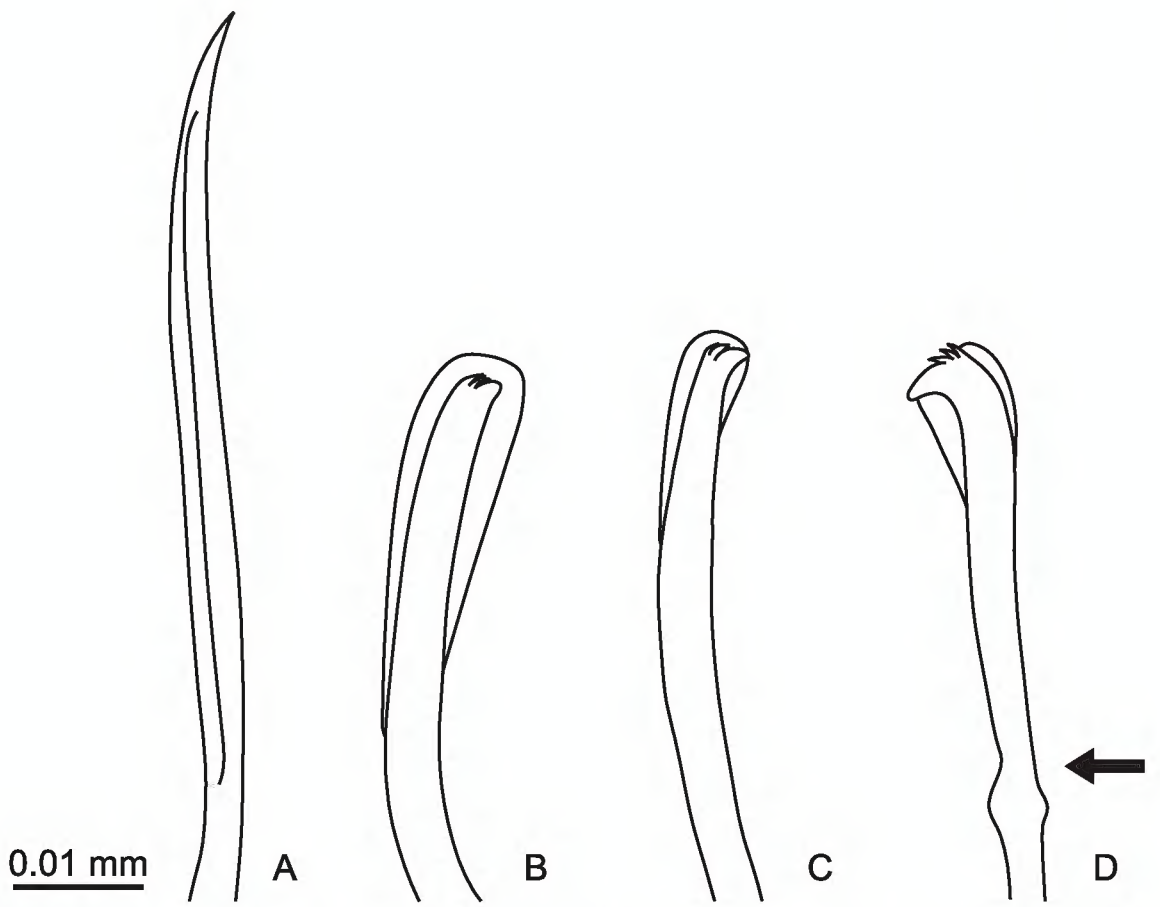

Figure 9. *Mediomastus hanedaensis* sp. n., paratype, CBM-ZW 1097. **A** Capillary chaeta from segment 2 **B** notopodial hooded hook from segment 9 **C** neuropodial hooded hook from segment 7 **D** notopodial hooded hook from segment 18; arrow indicates constriction.

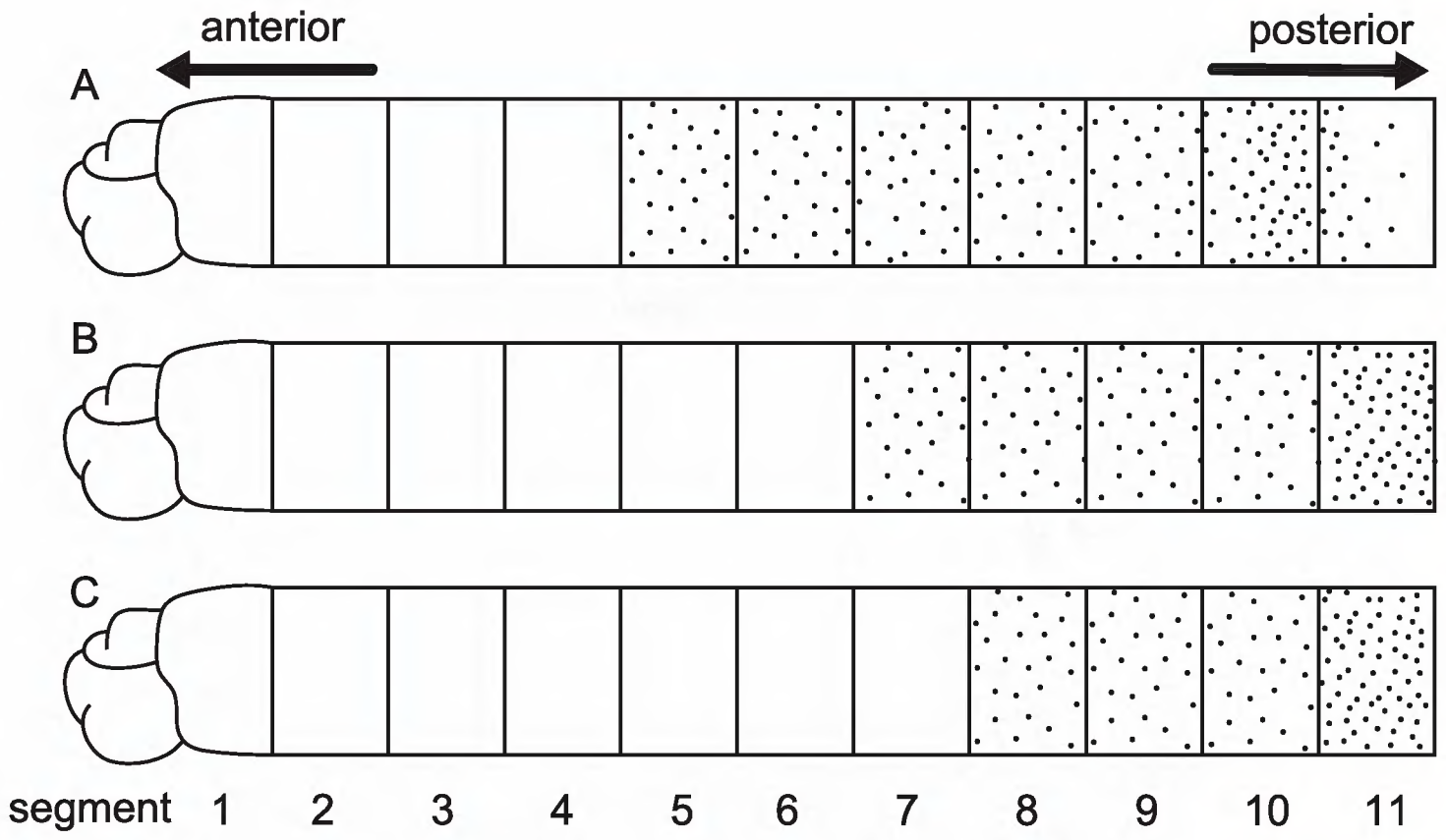

Figure 10. Diagram showing methyl-green staining patterns observed in the thorax (consisting of 11 segments) among three specimens of *Mediomastus hanedaensis* sp. n. **A** Paratype, CBM-ZW 1097 **B** paratype, CBM-ZW 1096 **C** holotype, CBM-ZW 1095.

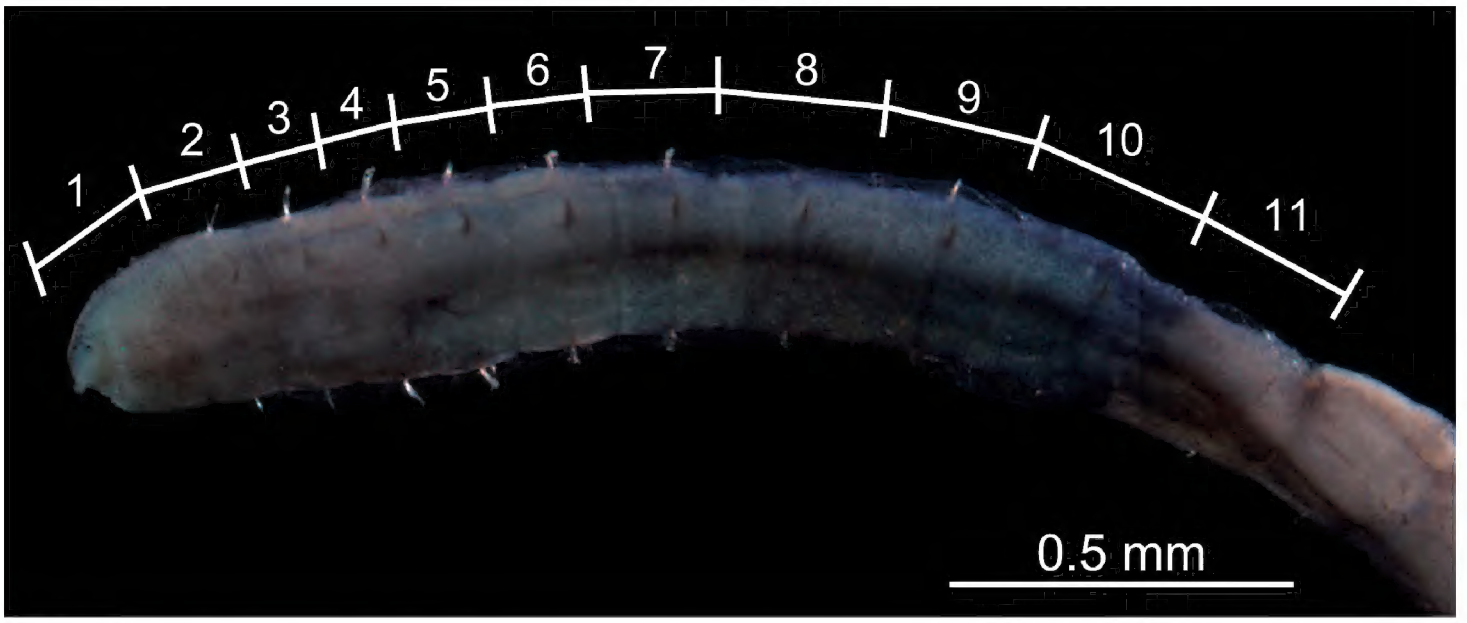

Figure 11. Photograph of the thorax of *Mediomastus hanedaensis* sp. n., holotype, CBM-ZW 1095, showing the methyl-green staining pattern, with the segment numbers and segmental boundaries labeled.

Key to species of genus *Mediomastus*

Data compiled from Hartman (1944, 1947, 1969), Hartmann-Schröder (1959, 1962), Day (1961), Pillai (1961), Rasmussen (1973), Ben-Eliahu (1976), Warren et al. (1994), Green (2002), Tomioka et al. (2013), and this study.

1	Abdominal capillary chaetae present **2**
–	Abdominal capillary chaetae absent **4**
2	Spine-like hooded hooks present ... ***Mediomastus ambiseta*** **(Hartman, 1947)**
–	Spine-like hooded hooks absent **3**
3	Thorax with unilimbate capillary chaetae .... ***Mediomastus setosus*** **Hartmann-Schröder, 1959**
–	Thorax with bilimbate capillary chaetae .... ***Mediomastus branchiferus*** **Hartmann-Schröder, 1962**
4	Paddle-like chaetae present ..... ***Mediomastus acutus*** **Hartman, 1969**
–	Paddle-like chaetae absent **5**
5	Thorax does not stain with methyl green **6**
–	Thoracic segments 1–4 stain with methyl green 7
–	Thoracic segments 5–11 stain with methyl green **8**
6	Eye spots present ..... ***Mediomastus fragilis*** **Rasmussen, 1973**
–	Eye spots absent ..... ***Mediomastus deductus*** **(Pillai, 1961)**
7	Thorax with whip-like capillary chaetae .... ***Mediomastus opertaculeus*** **Tomioka et al., 2013**
–	Thorax with unilimbate capillary chaetae .... ***Mediomastus duobalteus*** **sp. n.**
–	Thorax with bilimbate capillary chaetae ... ***Mediomastus warrenae*** **Green, 2002**
8	Thorax with whip-like capillary chaetae .... ***Mediomastus thomassini*** **Warren et al., 1994**

– Thorax with hook-tipped capillary chaetae ... ***Mediomastus capensis*** **Day, 1961**
– Thorax with unilimbate capillary chaetae **9**
9 Nephridiopores present **10**
– Nephridiopores absent **11**
10 Thoracic segments 6–10 do not stain uniformly with methyl green, resulting in striped pattern ..... ***Mediomastus australiensis*** **Warren et al., 1994**
– Thoracic segments 6–10 stain uniformly with methyl green..... ..... ***Mediomastus californiensis*** **Hartman, 1944**
11 Capillary chaetae with broad wing... ***Mediomastus cirripes*** **Ben-Eliahu, 1976**
– Capillary chaetae with narrow wing **12**
12 Parapodial ridge present..... ***Mediomastus calliopensis*** **Warren et al., 1994**
– Parapodial ridge absent ..... ***Mediomastus hanedaensis*** **sp. n.**

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